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Book Review

The Universe in Gamma Rays

edited by Volker Schonfelder
(Astronomy and Astrophysics Library, (eds) I Appenzeller *et al*)
Springer Verlag , Berlin Heidelberg-New York-London-Paris-Tokyo-Hong Kong (2001)
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Gamma Ray Astronomy has become one of the forefront research areas today, especially after the launching of Compton Gamma-Ray Observatory (CGRO). Scientific instruments aboard CGRO, such as BATSE, COMPTEL and EGRET have discovered a large number of new gamma-ray sources and mapped the distribution of the Gamma Ray Bursts (GRBs) most comprehensively than ever since. With the discovery of the X-ray and optical afterglows and their associate host galaxies, it is convincingly proven that the GRBs are cosmological.

While general astronomers and astrophysicists have curiosities in these and other high energy emitting objects in the universe, there was hardly any book which addressed the whole subject in a lucid manner so that it is accessible by all. The present book is an exception It has summarized the subject in a most timely manner when age-old confusion over the origin of the GRBs is on its way to a permanent resolution.

The book is a collection of articles from real experts in this subject All of them tried their best to start from scratch so that even non-experts may be tempted to go deeper very easily. Almost every topic of interest has been covered. The First Chapter by Dr. Schoenfelder introduces the subject to general readers and is very useful for the beginners. The Second Chapter by Dr Diehl deals with the physical processes such as nuclear transitions, pair annihilation, inverse compton scattering *etc* by which the Gamma Rays are produced. Also discussed in detail, are the absorption processes. In the Third Chapter by Dr. Lichti and Dr. Georgii, the typical instruments for the detection of gamma-rays are described. This includes the historical evolution of the gamma-ray telescopes, scintillation techniques, solid state detectors, spark chambers, Cerenkov detectors *etc*. Depending on how the instrument would be used, such as air shower having a large spread of incoming gamma-rays on earth or GRBs which are point-like but otherwise very energetic sources, the instrumentation vary. These are discussed with sufficient details while avoiding undue technicalities.

From Chapter Four onwards, one finds the description of actual sources of the gamma-rays in the universe. In Chapter Four by Dr. Schoenfelder, general gamma-ray background and all-sky maps are discussed. In Chapter Five by Dr. Rieger and Dr. Rank, description of all possible ways the gamma-rays are produced on the Sun, is provided Naturally, major focus is on the solar flares where particles are accelerated. Some discussion on particle acceleration, such as Fermi acceleration is also made. In Chapter Six by Dr. Kanbach, extremely high energy gamma-ray pulsars are described and methodology of how these are detected is given. Some theoretical aspects of production mechanism of high energy gamma rays are discussed. In Chapter Seven, Dr Collmar discusses gamma-ray emission from accretion disks around black holes and compact objects. A few special cases, such as Cyg X-3 and Cen X-3 are mentioned where even TeV and PeV gamma-rays may have been observed. In Chapter Eight, Dr. Iyudin and Dr. Kanbach present the gamma-ray emissions from the supernovae remnants and how these emissions are produced. Particle acceleration mechanism at the supernovae shock front is discussed. In Chapter Ten, Dr. Diehl talks about sites of nuclear reactions in the universe, starting from big bang to supernovae and stellar interior and how they contribute to the general gamma-ray background, both in the continuum and in line emissions.

When energetic nuclei interact with ambient medium, gamma-ray lines are expected. Dr. Schoenfelder and Dr. Strong discussed this phenomenon in great detail in Chapter Eleven. In Active galaxies, the source of all activities is ascribed to accretion processes. A part of the accretion energy is redirected towards a direction perpendicular to the disk in the form of jets. Particularly interesting are those which point directly towards us. These are called blazers and a significant amount of gamma-ray activity is seen in these objects. Dr. Collmar presented gamma-ray emission mechanisms in Active galaxies and Quasars in Chapter Twelve and discusses properties of gamma-ray emitting blazers as well.

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In contemporary gamma-ray astronomy, a big mystery is to identify the nature of the gamma-ray sources. While many of the sources observed in All Sky Surveys have been identified with pulsars or blazers, most remain unidentified, even today. This is discussed by Dr. Reimer in Chapter Thirteen. In Chapter Fourteen, Dr Weidenspointner and Dr. Varendorff discusses extragalactic gamma-ray background where the sources are unresolved This may have resulted due to superposition of point-like sources or combinations of diffuse and point-like sources. In this Chapter, most of the known types of possibilities such as normal galaxies, Active galaxies, Infra-red luminous galaxies, supernovae, primordial black holes, matter-antimatter annihilation, exotic elementary particles *etc* have been considered with great care and detail Finally, in Chapter Fifteen, gamma-ray bursts are discussed by Dr. Varendorff. After giving history of the discovery and properties, he went on the describe recent measurements by Beppo-sax satellite to observe the after-glows and how that helped measuring the distances of these bursts. A brief description of the current models have been presented. The origin remains a mystery and even today, new models are proposed in the literature.

In fine, it is to be said that the Editor, Dr. Schoenfelder has done an excellent job in compiling the finest articles encompassing every aspects of gamma-ray astronomy All the articles have ample numbers of Figures (in fact 141 of them in 15 articles, out of which 28 are colour Figures). The articles offer easy reading and readers with basic astronomy background would find no problem at all in understanding these articles The book is best suited for graduate students, and also an excellent handbook for references for any serious researchers

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